DOCUMENT RESUME

ED 023 885 08 VT 006 894

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Occupational Mathematics; Concepts of Decimals and Fractions. Report No. 16-I. Final Report.

Washington State Coordinating Council for Occupational Education, Olympia.; Washington State Univ., Pullman. Dept. of Education.
Spons Agency-Office of Education (DHEW), Washington, D.C.
Bureau No-BR-7-0031
Pub Date Jun 68
Grant-OEG-4-7-070031-1626
Note-63p.
EDRS Price MF-$0.50 HC-$3.25
Descriptors-*Arithmetic, *Decimal Fractions, *Programed Texts, *Vocational Education

This programed mathematics textbook is for student use in vocational education courses. It was developed as part of a programed series covering 21 mathematical competencies which were identified by university researchers through task analysis of several occupational clusters. The development of a sequential content structure was also based on these mathematics competencies. After completion of this program the student should know the place value concept for decimals and be able to convert fractions whose denominations are 10, 100, or 1000 to decimal form and write equivalent forms of integers and decimals by adding or removing zeros. The material is to be used by individual students under teacher supervision. Twenty-six other programed texts and an introductory volume are available as VT 006 882-VT 006 909, and VT 006 975. (EM)

ED023885

FINAL REPORT
Project No. 0e7-0031
Contract No. OEG-4-7-070031-1626
Report No. 16-1

Occupational Mathematics

CONCEPTS OF DECIMALS AND FRACTIONS

VT006894

June 1968

U.S. DEPARTMENT OF
HEALTH, EDUCATION AND WELFARE

Office of Education
Bureau of Research

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Occupational Mathematics

CONCEPTS OF DECIMALS AND FRACTIONS

Project No. 0E7-0031
Contract No. OEG-4-7-070031-1626
Report No. 16-1

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June 1968

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Washington State University, Department of Education, Pullman, Washington
State Coordinating Council for Occupational Education, Olympia, Washington

OBJECTIVES

1. The student should know the place value concept for decimals.

2. The student should be able to convert fractions whose denominators are 10, 100, or 1000 to decimal form.

3. The student should be able to write equivalent forms of integers and decimals by adding or removing zeros.

Greetings! You are about to begin improving your knowledge of basic mathematics. There are many important uses for the mathematics you are learning.

This booklet is not like your ordinary books. It is designed to help you learn as an individual. On the following pages you will find some information about mathematics. After the information is presented, you will be asked a question. Your answers to these questions will determine how you proceed through this booklet. When you have selected your answer to the question, turn to the page you are told to.

Do not write in this booklet. You may wish to have a pencil and some paper handy so you can write when you want to.

Remember this is not an ordinary book.

1. Study the material on the page.
2. Read the question on the page (you may want to restudy the material on the page).
3. Select the answer you believe is correct.
4. Turn to the page indicated by your answer.

Are you ready to begin?

(a) Yes — Turn to page 1

(b) No — Turn to page C

(c) HELP — Go see your teacher

Your answer was (b) No.

Well, this booklet is a little different.

Go back and read page B again. After you have read it, you will probably be ready to begin.

There are many common uses of decimals in everyday life. They occur many times and in many ways. For example, whenever you buy some goods at a store, you are being exposed to decimals. Let's say that you walk downtown with a friend to the ice cream store to buy two milkshakes and some candy. The clerk rings up $.84 on the cash register. The 84 cents is a decimal. Yet, you think nothing of it as you hand a dollar bill to the clerk and he gives you 16 cents in return. Another decimal.

Another example might be a track meet where the winning time in the 100-yard dash is 10.2 seconds. Here again decimals are being used.

You can see that you have probably been using decimals daily.

Now turn to page 2 and let's examine the nature of decimals.

In problems involving decimals, we assign a certain value to the places on each side of the decimal point.

For example: $\boxed{III}\ \boxed{II}\ \boxed{I} \cdot \boxed{A}\ \boxed{B}\ \boxed{C}$

$100\quad 10\quad 1 \qquad \frac{1}{10}\ \frac{1}{100}\ \frac{1}{1000}$

To the left of the decimal point we have block I in the one's place, block II in the ten's place, and block III in the hundred's place. On the right hand side of the decimal we have block A in the tenth's place, block B in the hundredth's place, and block C in the thousandth's place. Thus, in our base ten-place value system each digit represents a certain value according to its position in the number.

The idea of place value notation is that the value of the place immediately to the left of a given position is ten times the value of the given place. Each place immediately to the right of a given position is one-tenth of the value of the given place.

Now 1/10 (written as one-tenth) means one part of ten. Therefore, we write 1/10 as the decimal .1 (one-tenth) and 2/10 as .2 (two-tenths).

(continued)

Question:

8/10 (eight-tenths) would be written:

(a) .08 Turn to page 4

(b) 8.0 Turn to page 10

(c) .8 Turn to page 8

Incorrect!

Remember that the second place to the right of the decimal is the hundredth's place. Therefore, if we have .31, then we have 31/100.

How is the decimal .02 written as a fraction?

(a) 20/100 Turn to page 6

(b) 2/100 Turn to page 11

No! .8 = 8/10.

Remember the first place to the right of the decimal is the tenth's place.

Thus, .2 is 2/10

.8 is 8/10

The fraction 5/10 is equal to what decimal?

(a) 5.0 Turn to page 7

(b) .5 Turn to page 9

Very good! .16 = 16/100 or 16 pennies out of 100 pennies.

What fraction is equivalent to the decimal .425?

(a) 425/100 Turn to page 15

(b) 425/10 Turn to page 18

(c) 425/1000 Turn to page 12

Incorrect. The correct answer is 2/100.

The second place to the right of the decimal is the hundredth's value.

Go get help from your teacher and then return to page 2 of this unit.

Your answer is incorrect.

Ask your teacher for help and then return to page 2 of this unit.

Correct! .8 = 8/10 or 8 parts out of ten which is eight-tenths.

. A B C

In our diagram remember that B represents the hundredth's place.

From our example at the ice cream store you were given 16 cents, or $.16 in change.

What will the decimal .16 be as a fraction?

(a) 16/100 (sixteen hundredths) Turn to page 5

(b) 16/10 (sixteen tenths) Turn to page 3

Your answer of 5/10 = .5 is correct!

From . [A] [B] [C] you should remember that B represents the hundredth's place.

Recall our example at the ice cream store where you were given 16 cents ($.16) in change.

How can we write the decimal .16 as a fraction?

(a) 16/100 (sixteen hundredths) Turn to page 5

(b) 16/10 (sixteen tenths) Turn to page 3

No. .8 = 8/10.

Remember the first place to the right of the decimal is the tenth's place.

Thus, .2 is 2/10

.8 is 8/10

The fraction 5/10 is equal to what decimal?

(a) 5.0 Turn to page 7

(b) .5 Turn to page 9

Correct! .02 = 2/100.

Try this one.

What fraction is equal to the decimal .425?

(a) 425/100 Turn to page 17

(b) 425/1000 Turn to page 12

(c) 425/10 Turn to page 17

Excellent! .425 = 425/1000 (four hundred and twenty-five thousandths).

Now turn to page 22 and continue.

Your last answer was incorrect.

Ask your teacher for help, then return to page 2 of this unit.

Excellent! .036 = 36/1000.

Now turn to page 22 and continue.

Your answer is incorrect.

The third place to the right of the decimal is the thousandth's place. Thus, if we have .425, then we have 425 thousandths or 425/1000.

What decimal is the same as 327/1000?

(a) .327 Turn to page 20

(b) .0327 Turn to page 13

Oops! Don't let that zero fool you.

.036 still means we have 36 out of a possible 1000.

$$\frac{36}{1000}$$

Try this one.

.006 is equal to:

(a) 6/100 Turn to page 21

(b) 6/1000 Turn to page 19

Your answer is incorrect.

.425 is 425/1000 since the third place is the thousandth's value.

What fraction is equivalent to the decimal .036?

(a) 36/100 Turn to page 16

(b) 36/1000 Turn to page 14

Your answer is incorrect.

The third place to the right of the decimal is the thousandth's place. Thus, if we have .425, then we have 425 thousandths or 425/1000.

What decimal is the same as 327/1000?

(a) .327 Turn to page 20

(b) .0327 Turn to page 13

Very good! .006 is equal to 6/1000.

Now turn to page 22 and continue.

Good! 327/1000 = .327.

You remembered that the third place to the right of the decimal is the thousandths' place.

Try one more.

What fraction is equivalent to .036?

(a) 36/100 Turn to page 16

(b) 36/1000 Turn to page 14

Incorrect! .006 is the same as 6/1000, not 6/100.

Ask your teacher for help and then return to page 2 of this unit.

Any number of zeros may be added or removed from the right-hand side of a decimal without changing its value.

But you must <u>never</u> add or remove zeros from any other location.

<u>Correct</u>:

.3 = .30 = .300 = .3000

.24 = .240 = .2400 = .24000

.505 = .5050 = .50500 = .505000

<u>Incorrect</u>:

.3 ≠ .03 ≠ .003 ≠ .0003

.24 ≠ .024 ≠ .0024 ≠ .00024

.505 ≠ .5005 ≠ .50005

Turn to page 23

Which of the numbers below is equivalent to .25?

(a) .025 Turn to page 30

(b) .205 Turn to page 26

(c) .250 Turn to page 28

Very good! .0800 is the same as .08.

Try one more.

An equivalent form of 3.002 is:

(a) 3.0002 Turn to page 27

(b) 3.00200 Turn to page 29

(c) 3.0200 Turn to page 27

Excellent! You weren't fooled at all.

You saw that .01 = 1/100,

and that .0100 = 100/10000 which reduces to 1/100.

Now, turn to page 32.

Your answer is incorrect.

An examination of the fractions will show you why.

We started with .25

written as a fraction .25 = 25/100.

Your answer of .205 = 205/1000, which is not the same!

Remember, only add zeros <u>after</u> the number. For example:

.25 = .250

= .2500

= .25000, etc.

An equivalent form to .08 is:

(a) .0080 Turn to page 33

(b) .0800 Turn to page 24

Your last answer was incorrect.

You seem to be having trouble with this unit. Ask your teacher for help and then return to page 22 and continue.

Good! .25 does equal .250.

Try this one.

Which of the below is .01 equivalent to?

(a) .10 Turn to page 34

(b) .0100 Turn to page 25

(c) .100 Turn to page 34

Excellent! 3.002 equals 3.00200

Adding the two zeros to the right-hand side does not affect its value.

Now turn to page 32 and continue.

Your answer is incorrect.

An examination of the fractions will show you why.

We started with .25. Written as a fraction .25 = 25/100. Your answer of .025 = 25/1000. Clearly, 25/100 and 25/1000 are not equal.

An equivalent form to .08 is:

(a) .0080 Turn to page 33

(b) .0800 Turn to page 24

Which decimal form listed below is equal to the integer 17?

(a) 170.0 Turn to page 35

(b) 1.700 Turn to page 35

(c) 17.00 Turn to page 36

Integers can also be written in decimal form.

For example,

4 can be written 4.0

4.00

4.000, etc.

10 can be written 10.0

10.00

10.000, etc.

7 is 7.0

7.00

7.000, etc.

Turn to page 31.

Come on now! It's not that tough.

All that is being done is adding zeros on to the right-hand side of the decimal, which does not change the value.

For example, .3 becomes .30, .3000 -----

.25 becomes .250, .2500 -----

.08 becomes .080, .0800 --------

Return to page 23 of this unit and look more carefully at the problem. If you still can't get it, ask your teacher for help.

Incorrect! .01 is equivalent to .0100.

Remember that the only zeros that can be added or removed are those to the right-hand side of the last integer greater than zero.

Try this one.

An equivalent form of .08 is:

(a) .0080 Turn to page 33

(b) .0800 Turn to page 24

Oops!

17 can be written 17.0, 17.00, 17.000, etc.

You should notice that all the zeros are added after the decimal point.

Return to page 32 and look at the examples carefully; then continue from there.

Very good! Now that you can write decimals and integers in their correct forms, let's continue.

Turn to page 37.

Using the previous ideas in this unit, we can write the decimal form of 4 + 9/10 without actually adding the numbers. By examination of the problem, we can see that 4 + 9/10 = 4.9. The integer 4 is in the one's place, and 9/10 means a 9 in the <u>tenth's</u> place. Thus 4 + 9/10 = 4.9 and 3 + 7/10 = 3.7.

What decimal is equal to 6 + 8/100?

(a) 6.08 Turn to page 44

(b) 6.008 Turn to page 40

Correct! 3 + 3/10 = 3.3.

This same idea can be extended to 4 + 9/10 + 5/100. By examination, this can be written 4.95. The integer 4 is in the one's place. 9/10 means a 9 in the tenth's place, and 5/100 means a 5 in the hundredth's place.

Try this one.

5 + 4/10 + 1/100 can be written in decimal form as:

(a) 5.401 Turn to page 41

(b) 5.41 Turn to page 47

Incorrect. $2.414 = 2 + 4/10 + 1/100 + 4/1000$.

You seem to be having trouble recognizing the place value of decimals. Return to page 2 of this unit; and, once you have completed the section on place value notation, return to page 37.

Your answer of 6.008 is incorrect.

Let's look again at the problem. You want to write 6 + 8/100 in the decimal form. The integer 6 goes in the one's place. Since we have no tenth's, we use a zero; and then 8/100 means an 8 in the hundredth's place. Thus 6.08.

Try this one.

3 + 3/10 can be written as:

(a)	3.03	Turn to page 43
(b)	3.3	Turn to page 38

Your answer is incorrect.

Let's take another look. We have 5 + 4/10 + 1/100.

We start with the integer 5 in the one's place. Now 4/10 means a 4 in the tenth's place, and 1/100 means a 1 in the hundredth's place. Thus 5.41.

Which sum below is the same as 2.414?

(a) 2 + 4/10 + 14/100 Turn to page 39

(b) 2 + 4/10 + 1/100 + 4/1000 Turn to page 46

Your answer is incorrect.

30 + 1/100 + 9/1000 = 30.019.

Let's see why. We start with the integer 30. Then we have no tenths so we use a zero. Now 1/100 means a 1 in the hundredth's place, and 9/1000 means a 9 in the thousandth's place.

Thus 30.0 -- tenths

30.01 -- hundredths

30.019 -- thousandths

Try this one.

What is 9 + 3/10 + 8/1000 as a decimal?

(a) 9.308 Turn to page 48

(b) 9.380 Turn to page 49

Incorrect.

You seem to be having trouble with decimal forms. Return to page 2 of this unit and review the section on decimal notations and forms.

Then return to page 37.

Good! 6 + 8/100 = 6.08.

You saw that we start with a 6 in the one's place. Since we have no tenths, we use a zero. The 8/100 means an 8 in the hundredth's place. Thus 6.08.

This same idea can be extended to 4 + 9/10 + 5/100.

Using a 4 in the one's place	4.
then a 9 in the tenth's place	4.9
and a 5 in the hundredth's place	4.95

Now try this one.

5 + 4/10 + 1/100 can be written as:

(a)	5.401	Turn to page 41
(b)	5.41	Turn to page 47

Your answer is incorrect.

Let's look at the problem 30 + 1/100 + 9/1000.
We start with the integer 30. Then we add a zero
to the right of the decimal point as we have no tenths.
Now 1/100 means we place a 1 in the hundredth's place,
and we place a 9 in the thousandth's place for 9/1000.
Thus 30 + 1/100 + 9/1000 becomes 30.019.

Try this one.

How do you express 9 + 3/10 + 8/1000 as a decimal?

(a) 9.380 Turn to page 49

(b) 9.308 Turn to page 48

Very good! $2.414 = 2 + 4/10 + 1/100 + 4/1000$.

Try one more.

What is the decimal equivalent of $30 + 1/100 + 9/1000$?

(a) 3.0019 Turn to page 42

(b) 30.109 Turn to page 45

(c) 30.019 Turn to page 50

Very good! 5 + 4/10 + 1/100 = 5.41.

Try another one.

What is the decimal equivalent of 30 + 1/100 + 9/1000?

(a) 3.0019 Turn to page 42

(b) 30.109 Turn to page 45

(c) 30.019 Turn to page 50

Good! 9 + 3/10 + 8/1000 = 9.308.

Try this one.

What is 9 + 3/10 + 8/1000 equal to as a decimal?

(a) 9.308 Turn to page 50

(b) 9.380 Turn to page 51

Your answer is incorrect.

You seem to be having trouble with place value notation.

Return to page 2 of this unit and review place value.

Then return to page 37.

Very good! You have now shown that you understand the ideas of this unit. Let's review what we have done:

1. You have learned place value notation.

2. You have learned how to convert fractions whose denominators are 10, 100, or 1000 to decimal form.

3. You have learned how to express integers using a decimal form.

4. You have learned how to write equivalent decimal forms by adding or removing zeros.

Now you should be ready for a test over this unit. Tell your teacher that you have finished.

Incorrect! You almost had it there. Let's give you another chance.

The problem 9 + 3/10 + 8/1000 had the 3 in the tenths' place and the 8 in the thousandth's place, so we would write the decimal as 9.308.

You try this one.

Question:

2 + 4/10 + 1/100 + 4/1000 is equivalent to which of the following decimals?

(a) 24.14 Turn to page 43

(b) 2.414 Turn to page 46

(c) 2.0414 Turn to page 45

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CAI MATHEMATICS

TEST QUESTIONS

UNIT 8 - CONCEPTS OF DECIMALS AND FRACTIONS

1. In the number 18.2 2 is in the

   a) Ten's place

   b) One's place

   c) Tenths place

2. What Decimal is the same as 25/100

   a) 25.0

   b) 2.5

   c) .25

3. Which of the numbers below is equivalent to .25

   a) .250

   b) .205

   c) .025

4. In the number 365 3 is in the

   a) hundred's place

   b) one's place

   c) ten's place

5. What decimal is the same as 18/1

   a) 18.1

   b) 1.8

   c) 18.0

6. In the number 258.137 3 is in the

   a) Hundred's place

   b) Hundredth's place

   c) Tenth's place

7. An equivalent form of 5.002 is

   a) 5.00200

   b) 5.0002

   c) 5.0200

8. What decimal is the same as 325/1000

   a) 3.25

   b) .325

   c) .0325

9. An Equivalent form of .08 is

   a) .0080

   b) .800

   c) .0800

10. Each value to the <u>Left</u> of the decimal point is <u>1/10</u> the value of the given place

    a) yes

    b) no

11. The decimal .038 is the same as the fraction

    a) 38/100

    b) 38/1000

    c) 38.10,000

12. The number 4 can be written as 4.0, 4.00, 4.000

    a) yes

    b) no

13. In the number .138 the 3 stands for

    a) 3/10

    b) 3

    c) 3/100

14. The fraction 4/10 is the same as the decimal

    a) .04

    b) 4.0

    c) .4

15. Which decimal form is equal to the integer 17?

    a) 17.00

    b) 170.0

    c) 1.700

16. In the number 57.432 2 stands for

    a) 2/100

    b) 2/1000

    c) 2/10

17. What decimal is equal to 5 + 7/10

    a) 5.007

    b) 5.07

    c) 5.7

18. 4 + 3/100 can be written as

    a) 4.003

    b) 4.03

    c) 43.00

19. The decimal .425 is the same as the fraction

    a) 425/1000

    b) 425/100

    c) 425/10,000

20. The fraction 3/100 is the same as the decimal

    a) .03

    b) .003

    c) .300

21. The fraction 4/1000 is the same as the decimal

    a) .4000

    b) .0004

    c) .004

22. 5 + 4/10 + 1/100 can be written as

    a) 5.401

    b) 5.41

    c) 5.441

23. Which of the numbers below is equivalent to 3.17

    a) 31.7

    b) .3170

    c) 3.1700

24. The decimal .006 is equal to

    a) 6/100

    b) 6/1000

    c) 6/10004

Unit 8 (continued)

25. Which sum below is the same as 3.133?

a) 3 + 1/10 + 3/100 + 3/1000

b) 3.1 + 3/10 + 3/100

c) 3 + 3/10 + 3/100

ANSWER SHEET

Unit 8 - CONCEPTS OF DECIMALS AND FRACTIONS

1. c
2. c
3. a
4. a
5. c
6. b
7. a
8. b
9. c
10. b
11. b
12. a
13. c
14. c
15. a
16. b
17. c
18. b
19. a
20. a
21. c
22. b
23. c
24. b
25. a

To the instructor: The above problems are related to the objectives as follows:

OBJECTIVE 1 : Questions 1,4,6,10,13,16.

OBJECTIVE 2 : Questions 2,5.8,11,14.17,19,20,21.24

OBJECTIVE 3 : Questions 3.7,9.12,15,18,22.23,25

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION

ERIC REPORT RESUME

ERIC ACCESSION NO.

CLEARINGHOUSE ACCESSION NUMBER

RESUME DATE: June 1968 | P.A. | I.A.

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TITLE

Occupational Mathematics - CONCEPTS OF DECIMALS AND FRACTIONS

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INSTITUTION (SOURCE): Washington State University, Pullman, Washington, Dept. of Education — SOURCE CODE

REPORT/SERIES NO. Final Report No. 16-1 — SOURCE CODE

OTHER SOURCE — SOURCE CODE

OTHER REPORT NO. — SOURCE CODE

OTHER SOURCE

OTHER REPORT NO.

PUB'L. DATE June 1968 — CONTRACT GRANT NUMBER OEG-4-7-070031-1626

PAGINATION, ETC

55 pages

RETRIEVAL TERMS

Occupational mathematics
Programmed instruction
Learning decimals and fractions

IDENTIFIERS

Vo-Tech. Education Research and Development Project (no. 7-0031)

ABSTRACT:

One book of a 21-book series of programmed instruction materials designed to help pupils acquire mathematics capabilities most useful in sub-professional level occupations. Other programmed books in the series are:

Symbols
Representing Numbers by Letters
Equivalent Forms
Fraction and Ratio
Addition of Fractions
Subtraction of Fractions
Multiplication of Fractions
Division of Fractions
Addition and Subtraction of Decimals
Multiplication of Decimals
Division of Decimals
Conversion of Fractions into Decimals
Equivalent Forms of A = BC
Solutions of A = BC
Percentage
Commutative Law
Reciprocals
Scientific Notation
Proportions
Concepts of Number Bases